In the Claims

1. (Currently Amended): A low-mass roller, comprising:

a cylindrical body having an exterior surface, first and second open ends and defining an interior tubular space along a longitudinal axis therethrough for receiving an axle therein, said cylindrical body formed of polymeric material said cylindrical body having a diameter at said first and second ends that is smaller than a diameter thereof at at least one intermediate location along the longitudinal axis thereof with at least a portion of the exterior surface from the first end to the intermediate location and the second end to the intermediate location has a positive slope with respect to the longitudinal axis; and

an outer shell formed of metal proximately and conformally covering said exterior surface of and having a formed circular opening surrounding each said first and second ends of said cylindrical body, wherein said cylindrical body, said outer shell and said circular openings are concentric with said longitudinal axis, said outer shell disposed about said cylindrical body after formation of said cylindrical body.

2. (Original): The low-mass roller of Claim 1 wherein said outer shell comprises:

an assembly of first and second thin-walled tubular shells having inside diameters, at first respective ends thereof, equal within a predetermined tolerance wherein said first respective ends are joined together and welded.

3. (Previously Presented): The low-mass roller of Claim 2, wherein each said first and second tubular shells includes a second respective end opposite said first respective end such that an inward-extending lip formed in each said second respective end of said first and second tubular shells defines a circular alignment opening.

4. (Original): The low-mass roller of Claim 3, wherein each circular alignment opening defines a predetermined radius from said longitudinal axis.

5. (Original): The low-mass roller of Claim 2, wherein said assembly further comprises:

a weld ring having an outside diameter smaller than said inside diameters of each said first respective end of said first and second thin-walled tubular shells by a predetermined value, said weld ring disposed between and nested within said first respective ends of first and second thin-walled tubular shells such that said shells are held in alignment during said welding.

6. (Currently Amended): The low-mass roller of Claim 5 ~~Claim 3~~, wherein said weld ring further comprises:

a circular band having said outside diameter and having a circumferential ring disposed around said outside diameter of said circular band, said ring extending orthogonally from said band by a height greater by a predetermined distance than the thickness of said thin metal of said first and second thin-walled tubular shells.

7. (Previously Presented): The low-mass roller of Claim 3, further comprising:

a circular band formed of the same thin metal as said first and second thin-walled tubular shells.

8. (Original): The low-mass roller of Claim 1, wherein said outer shell comprises:

an assembly of first and second thin-walled tubular shells having inside diameters, at first respective ends thereof, equal within a predetermined tolerance wherein said first respective ends are joined together and welded; and

a weld ring having an outside diameter smaller than said inside diameters of each said first respective end of said first and second thin-walled tubular shells by a predetermined value, said weld ring disposed between and nested within said first respective ends of first and second thin-walled tubular shells such that said shells are held in alignment.

9. (Previously Presented): The low-mass roller of claim 6, wherein said circular band is formed of the same thin metal as said first and second thin-walled tubular shells.

10. (Original): The low-mass roller of Claim 1, wherein said outer shell is formed by an assembly of drawn first and second thin-walled tubular shells having inside diameters, at first respective ends thereof, equal within a predetermined tolerance wherein said first respective ends are joined together and welded.

11. (Original): The low-mass roller of Claim 10, wherein said assembly further comprises:

a weld ring having an outside diameter smaller than said inside diameters of each said first respective end of said first and second thin-walled tubular shells by a predetermined value, said weld ring disposed between and nested within said first respective ends of first and second thin-walled tubular shells such that said shells are held in alignment during said welding.

12. (Original): The low-mass roller of Claim 11, wherein said weld ring further comprises:

a circular band having said outside diameter and having a circumferential ring disposed around said outside diameter of said circular band, said ring extending orthogonally from said band by a height greater by a predetermined distance than the thickness of said thin metal of said first and second thin-walled tubular shells.

13. (Original): The low-mass roller of Claims 11, wherein said weld ring further comprises:

a circular band formed of the same thin metal as said first and second thin-walled tubular shells.

14. (Original): The low-mass roller of Claim 1, wherein said outer shell is formed by an assembly of stamped first and second thin-walled tubular shells having inside diameters, at first respective ends thereof, equal within a predetermined tolerance wherein said first respective ends are joined together and welded.

15. (Original): The low-mass roller of Claim 14, wherein said assembly further comprises:

a weld ring having an outside diameter smaller than said inside diameters of each said first respective end of said first and second thin-walled tubular shells by a predetermined value, said weld ring disposed between and nested within said first respective ends of first and second thin-walled tubular shells such that said shells are held in alignment during said welding.

16. (Original): The low-mass roller of Claim 15, wherein said weld ring further comprises:

a circular band having said outside diameter and having a circumferential ring disposed around said outside diameter of said circular band, said ring extending orthogonally from said band by a height greater by a predetermined distance than the thickness of said thin metal of said first and second thin-walled tubular shells.

17. (Original): The low-mass roller of Claim 15, wherein said weld ring further comprises:

a circular band formed of the same thin metal as said first and second thin-walled tubular shells.

18. (Original): The low-mass roller of Claim 1, wherein said outer shell conforms to a crowned outline in longitudinal cross-section defined by a first outer diameter of said first and second open ends that is less than a second outer diameter located approximately midway between said first and second open ends.

19. (Previously Presented): The low-mass roller of Claim 1 wherein said cylindrical body has a wall thickness substantially thicker than said metal of said outer shell.

20. (Original): The low-mass roller of Claim 1, wherein said polymeric material is electrically non-conductive.

21. (Original): The low-mass roller of Claim 1, wherein said polymeric material is electrically conductive.

22. (Original): The low-mass roller of Claim 1, wherein said polymeric material is an acoustic absorber.

23. (Original): The low-mass roller of Claim 1, wherein said polymeric material is acoustically inert.

24. (Withdrawn): A weld ring for joining first and second round, thin-walled tubes of a uniform wall thickness, like inside diameter and like material, comprising:

a circular band of said like material having first and second parallel edges, a band inside diameter and an outside diameter equal to or slightly less than said like inside diameter of said first and second tubes; and

a circumferential ring of said like material extending orthogonally outward by a height greater than said wall thickness from said outside diameter around said band and disposed approximately midway between said first and second parallel edges of said band; wherein

said circular band and said circumferential ring are formed as one piece of said like material.

25. (Withdrawn): The weld ring of Claim 24, wherein said weld ring in use being disposed with each said first and second edge of said circular band portion inserted in nested relationship within a respective end of one of said first and second tubes and each said respective end of said first and second tubes butted up against a proximate side of said circumferential ring portion of said weld ring.

26. (Withdrawn): The weld ring of Claim 24, wherein said like material of said circular band and circumferential ring portions is a metal capable of joining said first and second thin-walled tubes of said like material by a welding process.

27. (Withdrawn): The weld ring of Claim 26, wherein said metal like material of said weld ring and said first and second thin-walled tubes is stainless steel.

28. (Withdrawn): The weld ring of Claim 24, wherein said like material of said circular band and said circumferential ring portions is a non-metallic material capable of joining said first and second thin-walled tubes of said non-metallic material by a process selected from the group consisting of welding, cementing, gluing and epoxying.

29. (Withdrawn): The weld ring of Claim 26, wherein said welding process comprises a process performed using energy of a form selected form the group consisting of thermal energy, electric energy, optical energy, chemical energy and acoustic energy.

30. (Withdrawn): The weld ring of Claim 28, wherein said welding process comprises a process performed using energy of a form selected form the group consisting of thermal energy, electric energy, optical energy, chemical energy and acoustic energy.

31. (Withdrawn): The weld ring of Claim 24, wherein said circular band and said circumferential ring are formed of one piece of said like material by a process selected from the group consisting of machining, casting and molding.

32. (Withdrawn): A method for making a low-mass roller, comprising the steps of:

forming a thin-walled, cylindrical outer shell of the low-mass roller of metal, the outer shell having an exterior surface, an interior surface and a longitudinal axis coincident with an axis of rotation of the low-mass roller, the outer shell further having first and second ends; and

forming a hollow body in situ within the outer shell of a polymeric material such that the assembly of the outer shell and the hollow body remain in contact with the interior surface of the outer shell and further such that the hollow body defines a cylindrical axial space surrounding and coincident with said axis of rotation for receiving an axle.

33. (Withdrawn): The method of Claim 32, wherein the step of forming a thin-walled, cylindrical outer shell comprises the step of:

shaping the first and second ends of the outer shell to define circular alignment openings and partially enclose the polymeric hollow body within the outer shell.

34. (Withdrawn): The method of Claim 32, wherein the step of forming a hollow body comprises the step of:

providing a wall-thickness of the hollow body substantially greater than the wall-thickness of the thin-walled outer shell.

35. (Withdrawn): The method of Claim 32, wherein the step of forming a hollow body comprises the steps of:

forming the hollow body of a polymeric material that conducts electricity.

36. (Withdrawn): The method of Claim 32, wherein the step of forming a thin-walled, cylindrical outer shell comprises the steps of:

forming first and second tubular shell sections of the thin-walled metal and having inside diameters, equal within a predetermined tolerance, at first respective ends thereof;

assembling the first respective ends of the first and second tubular shell sections upon a weld ring disposed therebetween; and

welding the assembled first and second tubular shell sections and the weld ring together.

37. (Withdrawn): The method of Claim 36, wherein the step of forming comprises the steps of:

performing a drawing operation upon a pre-shaped sheet metal blank;

trimming the drawn tubular shell section to a predetermined dimension; and

removing material from an end opposite from the first respective end of the tubular shell section along and perpendicular to the longitudinal axis.

38. (Withdrawn): The method of Claim 37, wherein the step of performing comprises pre-shaping the sheet metal blank from stainless steel.

39. (Withdrawn): The method of Claim 36, wherein the step of forming comprises performing a process upon a sheet metal blank selected from the group consisting of drawing, spinning and stamping processes.

40. (Withdrawn): The method of Claim 36, wherein the step of providing a weld ring comprises the step of:

forming the weld ring as a single piece of the same material as the first and second tubular shell sections by at least one process selected from the group consisting of machining, forging, stamping, casting and molding.

41. (Withdrawn): The method of Claim 36, wherein the step of assembling further comprises the step of:

supporting the assembled portions of the outer shell in a true alignment along the longitudinal axis.

42. (Withdrawn): The method of Claim 36, wherein the step of welding comprises the steps of:

applying the welding energy to the outermost edge of the circumferential ring such that welding occurs at the interface between the weld ring and the first and second tubular shell sections; and

smoothing the exterior surface of the welded outer shell to provide a uniform exterior surface finish.

43. (Withdrawn): The method of Claim 42, wherein the step of smoothing comprises the steps of:

grinding a weld bead surrounding the cylindrical outer shell to provide a continuous surface at a constant radius from the longitudinal axis across the region of the weld ring; and

polishing the exterior surface of the cylindrical outer shell.

44. (Withdrawn): A method for joining first and second thin-walled tubing sections having an equal first cross-section with the other, comprising the steps of:

cutting a first end, of a first thin-walled tubing section to be joined, at a first angle with respect to the longitudinal centerline of the first tubing section;

cutting a first end, of a second thin-walled tubing section to be joined, at the first angle with respect to the longitudinal centerline of the second tubing section; and

assembling the first ends of the first and second thin-walled tubing sections together end-to-end and overlapping respective sides of an outer surface of a band portion of a weld ring disposed in a nesting relationship therewith, wherein the weld ring includes a circumferential ring portion around the outer surface of the band portion of the weld ring and extending outward from the outer surface of the band portion of the weld ring at the first angle with respect to the longitudinal centerline of the joined first and second thin-walled tubing sections such that the circumferential ring portion of the weld ring is disposed between the respective first ends of the first and second thin-walled tubing sections.

45. (Withdrawn): The method of Claim 44, wherein the first angle with respect to the longitudinal centerline of the first and second tubing sections and the weld ring is 90 degrees within a predetermined tolerance.

46. (Withdrawn): The method of Claim 45, wherein the predetermined tolerance is plus or minus one degree.

47. (Withdrawn): The method of Claim 44, further comprising the step of:

fabricating the weld ring of a section of thin-walled tubing having the same cross-section shape as the first and second thin-walled tubing sections and outer cross-section dimensions less than corresponding inner cross-section dimensions of the first and second thin-walled tubing sections such that the band portion of the weld ring may be nested within and in contact with the respective first ends of the first and second thin-walled tubing sections; and

fabricating the circumferential ring portion of the weld ring around the outer surface of the weld ring such that the circumferential ring portion extends from the outer surface of the weld ring

by a height greater by a predetermined distance than the wall thickness of the thin-walled tubing sections.

48. (Withdrawn): The method of Claim 44, further comprising the steps of:

supporting the assembly of the first and second thin-walled tubing sections upon the weld ring in uniform alignment with the longitudinal centerline; and welding the weld ring to the assembled tubing sections by applying welding energy to the circumferential ring portion of the weld ring.

49. (Currently Amended): A low-mass roller, comprising:

first and second tubular shells formed of a thin metal and having substantially equal inside diameters at first respective ends thereof, said first respective ends of said first and second tubular shells joined in nested relationship over each side of a weld ring disposed between said first respective ends and welded thereto to form a single cylindrical outer shell of said low-mass roller, said outer shell defining a longitudinal axis therethrough;

a continuous body, molded of polymeric material in situ within said outer shell, defining a tubular space therethrough for receiving an axle therewithin and along said longitudinal axis;

wherein each said first and second tubular shell includes a respective second end opposite said first respective end such that an inward-extending lip formed in each said second respective end of said first and second tubular shells defines a circular alignment opening with at least a portion of the interior surface of each said first and second tubular shell having a positive slope from said second end to said first end with respect to the longitudinal axis; and

said first and second tubular shells are assembled after formation of said continuous body.

50. (Original): The low-mass roller of Claim 49, wherein said weld ring is formed of said thin metal and having a outside diameter dimensioned to allow said nesting of said weld ring within each said first respective end of said first and second tubular shells such that said first and second tubular shells are held in alignment during welding.

51. (Canceled)

52. (Previously Presented): The low-mass roller of Claim 49, wherein each circular alignment opening defines a predetermined radius from said longitudinal axis.

53. (Original): The low-mass roller of Claim 49, wherein said outer shell conforms to a crowned profile in any plane cross-section containing said longitudinal axis, said crowned profile defined by a first outer diameter of said outer shell proximate to said weld ring and a smaller second outer diameter of said outer shell at second respective ends of said outer shell distant from said weld ring.

54. (Original): The low-mass roller of Claim 49, wherein said outer shell has a wall thickness less than or equal to one-twentieth part of said inside diameter.

55. (Original): The low-mass roller of Claim 50, wherein said weld ring further comprises:

a circular band having said outside diameter and further including a circumferential ring disposed around said outside diameter of said circular band, said circumferential ring extending orthogonally from said band by a height greater by a predetermined distance than the thickness of said thin metal of said first and second thin-walled tubular shells.

56. (Original): The low-mass roller of Claim 50, wherein said weld ring comprises a circular band formed of said thin metal.

57. (Original): The low-mass roller of Claim 49, wherein said first and second tubular shells are formed of stainless steel.

58. (Original): The low-mass roller of Claim 49, wherein said first and second tubular shells are substantially identical half-shells each having a cylindrical cross-section and a first inside diameter at said first respective end and a second inside diameter at a second end thereof smaller than said first inside diameter.

59. (Original): The low-mass roller of Claim 49, wherein said continuous body molded in situ within said outer shell has a wall thickness substantially thicker than said thin metal of said outer shell.

60. (Original): The low-mass roller of Claim 49, wherein said polymeric material is electrically non-conductive.

61. (Original): The low-mass roller of Claim 49, wherein said polymeric material is electrically conductive.

62. (Original): The low-mass roller of Claim 49, wherein said polymeric material is acoustically non-resonant.

63. (Currently Amended): A roller, comprising:

an outer tubular shell with a substantial portion thereof drawn and having a first end and a second end with an exterior surface and an interior surface and with a varying inner diameter from said first and second ends inward therefrom to an intermediate location such that the inner diameter of a central portion at the intermediate location thereto is greater than the inner diameter at the distal ends with at least a portion of the exterior surface from the first end to the intermediate location and the second end to the intermediate location having a positive slope with respect to the longitudinal axis; and

an inner support structure disposed proximate the interior surface of said outer tubular shell and said outer tubular shell assembled about said inner support structure after formation of said inner support structure.

64. (Original): The roller of Claim 63, wherein the diameter of said outer tubular shell is maximum at substantially the center thereof.

65. (Original): The roller of Claim 63, wherein said inner support structure is disposed adjacent the interior surface of said outer tubular shell.

66. (Original): The roller of Claim 63, wherein said outer tubular shell has a thickness that is substantially the same from said first to said second end.

67. (Original): The roller of Claim 63, wherein said inner support structure has a bore formed therethrough and substantially along the longitudinal axis of said outer tubular shell.

68. (Original): The roller of Claim 63, wherein said inner support structure is formed of a polymeric material.

69. (Original): The roller of Claim 68, wherein said outer tubular shell is comprised of stainless steel.

70. (Original): The roller of Claim 69, wherein said outer tubular shell has a lip formed at at least said first end that extends downward at a rate portion of said inner support structure.

71. (Original): The roller of Claim 70, wherein said outer tubular shell has a lip formed over said second end and extending down over a portion of said inner support structure.

72. (Original): The roller of Claim 63, wherein said outer tubular shell has a crowned profile.

73. (Currently Amended): A low-mass roller, comprising:

first and second tubular shells formed of a thin metal and having substantially equal inside diameters at first respective ends thereof;

a weld ring formed of said thin metal and having an outer diameter dimensioned to allow nesting of a portion of said weld ring within each said first respective end of said first and second tubular shells when said shells are assembled on and welded to said weld ring to form a single cylindrical outer shell of said low-mass roller, said outer shell defining a longitudinal axis therethrough; and

a continuous body defining a tubular space for receiving an axle along said longitudinal axis, said continuous body molded of a polymeric material in situ within said outer shell and

substantially conformal therewith, and having an outer diameter that increases from the distal end inward and having on at least a portion of the exterior surface thereof a positive slope with respect to the longitudinal axis.

74. (Original): The method of Claim 36, further comprising the step of:

providing a weld ring band portion having an outside diameter sized to nest within the inside diameter at each first respective end of the first and second tubular shell sections wherein further a circumferential ring is disposed around the outside diameter of the band portion along a midline of the band portion and extending orthogonally from the midline of the outside diameter of the band portion of the weld ring.

75. (Original): The method of Claim 74, further comprising the step of:

nesting the weld ring within and between the first respective ends of the first and second tubular shell sections upon assembly thereof such that the first respective ends of the first and second tubular shell sections are butted against respective sides of said circumferential ring.